ERRATA ENERGY AND MOMENTUM ASSOCIATED WITH GÖDEL UNIVERSE

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In a recent paper,¹ we have evaluated energy and momentum densities for stationary and non-stationary forms of Gödel universe using Einstein and Papapetrou's prescriptions. During the extension of the procedure for spacetime homogeneous Gödel-type metrics, we have found an error in the paper.¹ The error is, indeed, very simple and occurs in the components g^{01} and g^{02} during inverting the metric. However, when we remove this error and redo all the calculations, the results are surprisingly very simple and more interesting. In this erratum, we would give the corrected expressions of the energy–momentum densities.

The correct non-vanishing components of H_a^{bc} required to energy and momentum densities in Einstein's prescription² are

$$H_0^{01} = \frac{x}{\sqrt{2}r^3}(e^{ar} + 2r^2e^{-ar}), \quad (1)$$

$$H_0^{02} = \frac{y}{\sqrt{2}r^3}(e^{ar} + 2r^2e^{-ar}), \quad (2)$$

$$H_1^{01} = -\frac{a}{\sqrt{2}r^4}xye^{2ar}, \quad (3)$$

$$H_1^{02} = -\frac{1}{\sqrt{2}r^4}(2r^3 + ay^2e^{2ar}), \quad (4)$$

$$H_2^{01} = \frac{1}{\sqrt{2}r^4}(2r^3 + ax^2e^{2ar}), \quad (5)$$

$$H_2^{02} = \frac{a}{\sqrt{2}r^4}xye^{2ar}, \quad (6)$$

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$$H_0^{12} = \sqrt{2}a, \quad (7)$$

$$H_0^{03}, \quad H_1^{03}, \quad H_2^{03}, \quad H_3^{01}, \quad H_3^{02}, \quad H_0^{23}, \quad H_0^{31} = 0. \quad (8)$$

When we use these corrected values of H_a^{bc} , we obtain much simpler energy and momentum densities in Einstein's prescription. These are given as

$$\Theta_0^0 = \frac{(1-ar)}{16\sqrt{2}\pi r^3}[-e^{ar} + 2r^2e^{-ar}], \quad (9)$$

$$\Theta_1^0 = \frac{y}{16\sqrt{2}\pi r^4}[2r + a(1-2ar)e^{2ar}], \quad (10)$$

$$\Theta_2^0 = -\frac{x}{16\sqrt{2}\pi r^4}[2r + a(1-2ar)e^{2ar}], \quad (11)$$

$$\Theta_0^1 = \Theta_0^2 = \Theta_0^3 = \Theta_3^0 = 0. \quad (12)$$

Now inserting the correction in energy-momentum complex of Papapetrou,³ we obtain the following non-vanishing components of N^{abcd} as

$$N^{0011} = \frac{y^2}{\sqrt{2}r^3}(e^{ar} - 2r^2e^{-ar}), \quad (13)$$

$$N^{0012} = -\frac{xy}{\sqrt{2}r^3}(e^{ar} - 2r^2e^{-ar}), \quad (14)$$

$$N^{0022} = \frac{x^2}{\sqrt{2}r^3}(e^{ar} - 2r^2e^{-ar}), \quad (15)$$

$$N^{0121} = -\sqrt{2}\frac{x}{r}, \quad (16)$$

$$N^{0122} = -\sqrt{2}\frac{y}{r}. \quad (17)$$

Making use of these values, we get the following corrected energy and momentum density components in Papapetrou's prescription

$$\Omega^{00} = \frac{(1-ar)}{16\sqrt{2}\pi r^3}(e^{ar} + 2r^2e^{-ar}), \quad (18)$$

$$\Omega^{01} = \frac{y}{8\sqrt{2}\pi r^3}, \quad (19)$$

$$\Omega^{02} = -\frac{x}{8\sqrt{2}\pi r^3}, \quad (20)$$

$$\Omega^{03} = \Omega^{30} = 0. \quad (21)$$

Here we have given the correct values of the energy and momentum density components for a Gödel metric by using prescriptions of Einstein and Papapetrou. It can be seen that the corrected version of the energy and momentum densities are much simple in both the prescriptions. It is interesting to note from Eqs. (9)–(11)

and (18)–(20) that though the energy–momentum complexes of Einstein and Papapetrou are not exactly the same, they are similar up to certain terms. The energy density is almost the same in both the prescriptions while the momentum density components exactly coincide for the first term.

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